OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **WARREN LAKE** the program coordinators recommend the following actions.

FIGURE INTERPRETATION

- Figure 1: These graphs illustrate concentrations of chlorophyll-a in the water column. Algae are microscopic plants that are a natural part of lake ecosystems. Algae contain chlorophyll-a, a pigment necessary for photosynthesis. A measure of chlorophyll-a can indicate the abundance of algae in a lake. The chlorophyll-a concentration decreased from that of last season, however, the lake was sampled only once this summer so an accurate analysis is difficult. Algal abundance remained above the New Hampshire mean reference line for the past two summers. The plankton sample contained blue-green algae, and the species *Coelosphaerium* was the third most abundant alga. Blue-green algae can be indicators of pollution and can become a nuisance alga if the right conditions persist. While algae are present in all lakes, an excess amount of any type is not welcomed. Concentrations can increase when there are internal and external sources of phosphorus, which is the nutrient algae depend upon for growth. It's important to continue the education process and keep residents aware of the sources of phosphorus and how it influences lake quality.

- Figure 2: Water clarity is measured by using a Secchi disk. Clarity, or transparency, can be influenced by such things as algae, sediments from erosion, and natural colors of the water. The graphs on this page show historical and current year data. The lower graph shows lake transparency was similar to the 1999 result, but has decreased since the readings of 1991 and 1992. Transparency remained low and the high chlorophyll concentrations most likely decreased the clarity of the water. The transparency was below the state mean. The 2000 sampling season was considered to be wet and, therefore, average transparency readings are expected to be slightly lower than last year's readings. Higher amounts of rainfall usually cause more eroding of sediments into the lake and streams, thus decreasing clarity.

- Figure 3: These figures show the amount of phosphorus in the epilimnion (the upper layer in the lake) and the hypolimnion (the

lower layer), although the latter has not been sampled since 1991; the inset graphs show current year data. Phosphorus is the limiting nutrient for plants and algae in New Hampshire waters. Too much phosphorus in a lake can lead to increases in plant growth over time. These graphs show in-lake phosphorus levels remain *stable* and within the normal range for New Hampshire waters. The phosphorus concentration remained below the New Hampshire median, and was consistent with last season's concentration. Sampling at least once per month in the summer will allow us to accurately track the phosphorus trend in the lake. This would also allow us to understand how the phosphorus concentrations are affecting algae growth in the lake. One of the most important approaches to reducing phosphorus levels is educating the public. Humans introduce phosphorus to lakes by several means: fertilizing lawns, septic system failures, and detergents containing phosphates are just a few. Keeping the public aware of ways to reduce the input of phosphorus to lakes means less productivity in the lake. Contact the VLAP coordinator for tips on educating your lake residents or for ideas on testing your watershed for phosphorus inputs.

OTHER COMMENTS

- Conductivity levels were lower throughout much of the Warren Lake watershed (Table 6). The rains this summer helped to dilute and flush pollutants from the waters, while last year's dry summer concentrated pollutants. Septic system leachate, agricultural runoff, iron deposits, and road runoff can all influence conductivity.

- Total phosphorus concentrations were also lower in many of the tributaries, except Pickerel Cove Bk and Smith Hill Bk (Table 8). Pickerel Cove Bk's concentration was only slightly elevated and remained in the normal range for New Hampshire's waters (see Chemical Monitoring Parameters section of the report). The Smith Hill Bk concentration, on the other hand, was elevated to the high range. It may be that the brook had low flow at the time of sampling, which would cause the phosphorus to be concentrated more heavily in the water.

- Dissolved oxygen was high throughout the water column (Table 9). Shallow ponds tend to mix continuously by wind and wave action, thereby allowing for oxygen exchange with the atmosphere.

- *E. coli* originates in the intestines of warm-blooded animals (including humans) and is an indicator of associated and potentially harmful pathogens. Bacteria concentrations were low at the sites tested (Table 12). If residents are concerned about septic system impacts, testing when the water table is high or after rains is best. Please consult the Other Monitoring Parameters section of the report for the current standards for *E. coli* in surface waters.

NOTES

- Monitor's Note (9/6/00): Saw one loon, painted turtle.

USEFUL RESOURCES

The Blue Green Algae. North American Lake Management Society, 1989. (608) 233-2836 or www.nalms.org

Weed Watchers: An Association to Halt the Spread of Exotic Aquatic Plants, WD-BB-4, NHDES Fact Sheet, (603) 271-3503 or www.state.nh.us

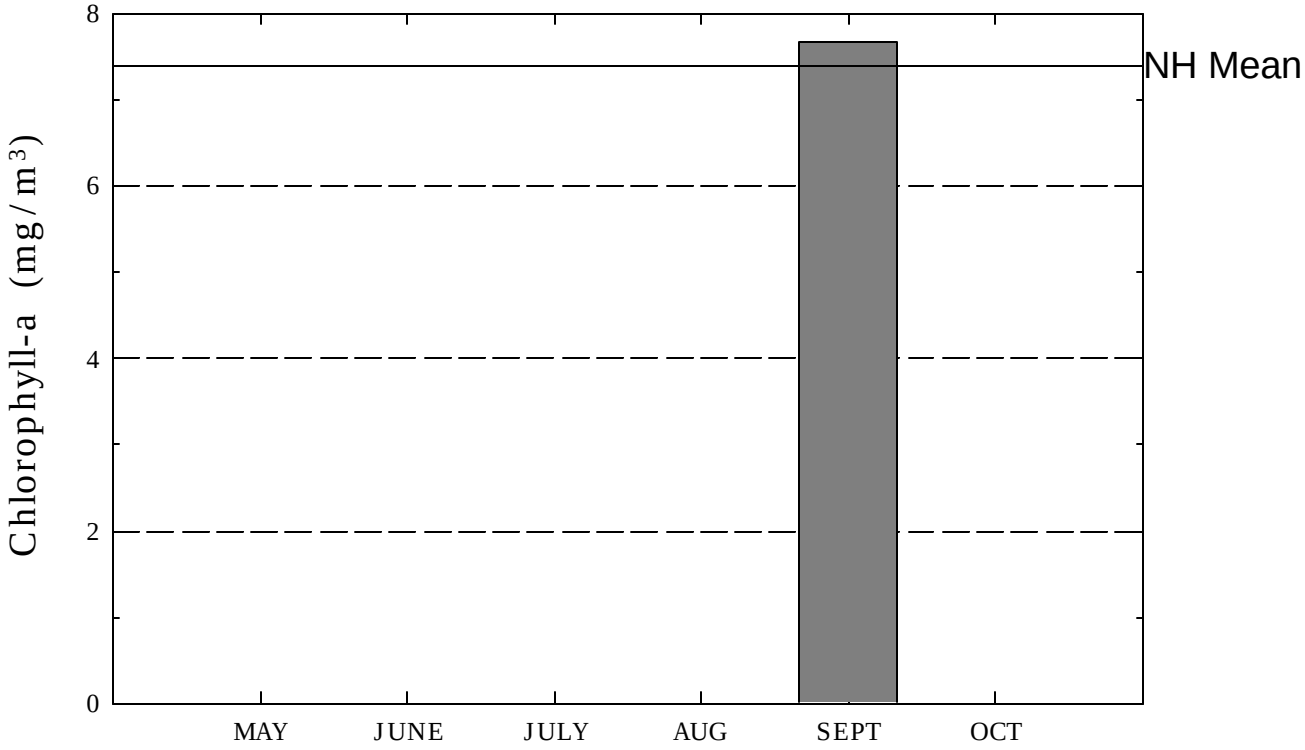
Vegetated Phosphorus Buffer Strips, NH Lakes Association pamphlet, (603) 226-0299 or www.nhlakes.org

Effects of Phosphorus on New Hampshire's Lakes, NH Lakes Association pamphlet, (603) 226-0299 or www.nhlakes.org

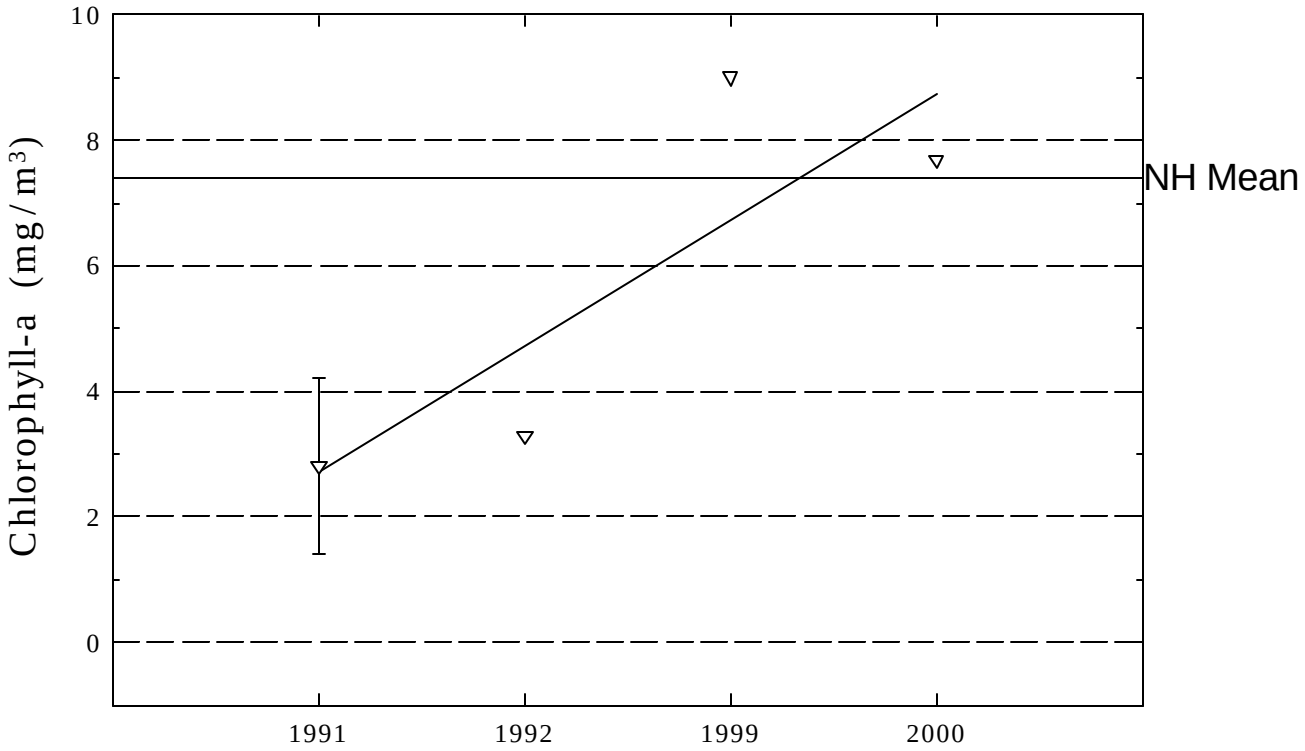
Answers to Common Lake Questions, NHDES-WSPCD-92-12, NHDES Booklet, (603) 271-3503.

Warren Lake

Figure 1. Monthly and Historical Chlorophyll-a Results



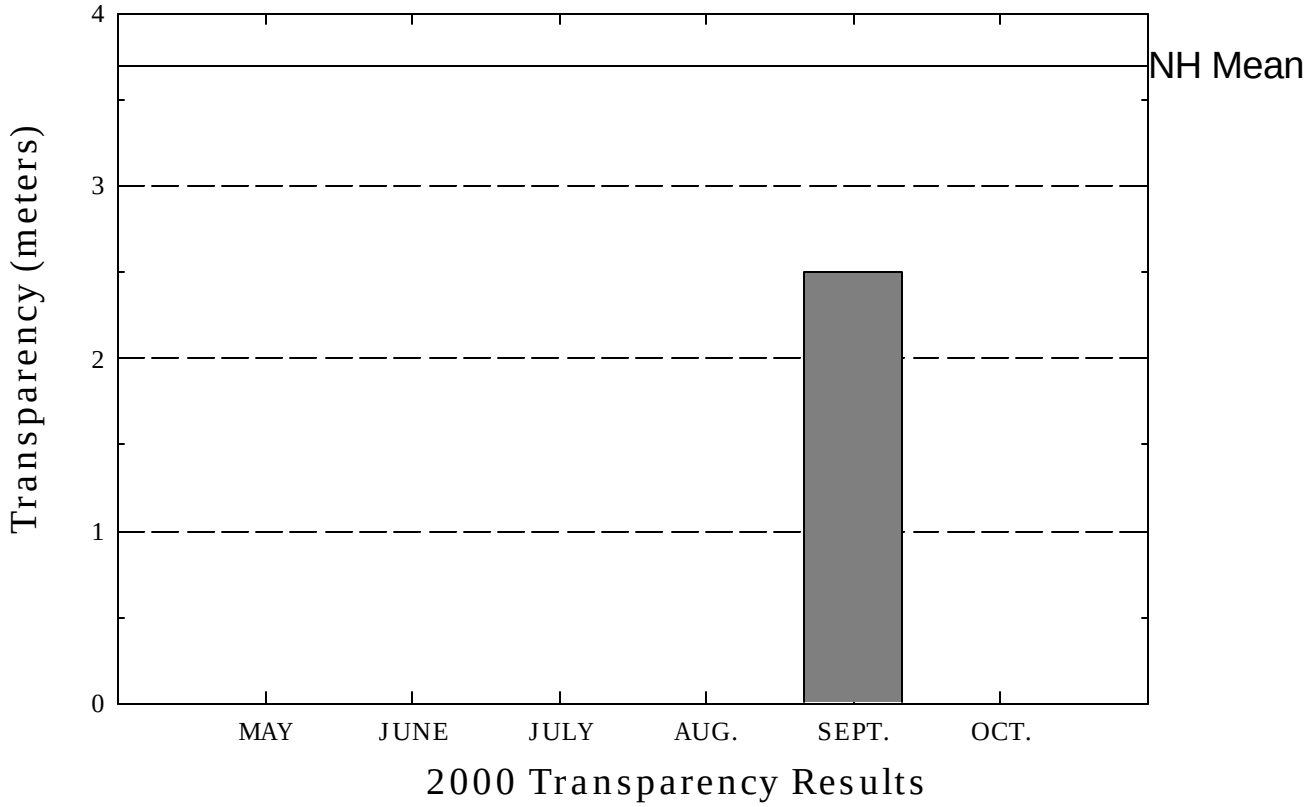
2000 Chlorophyll-a Results

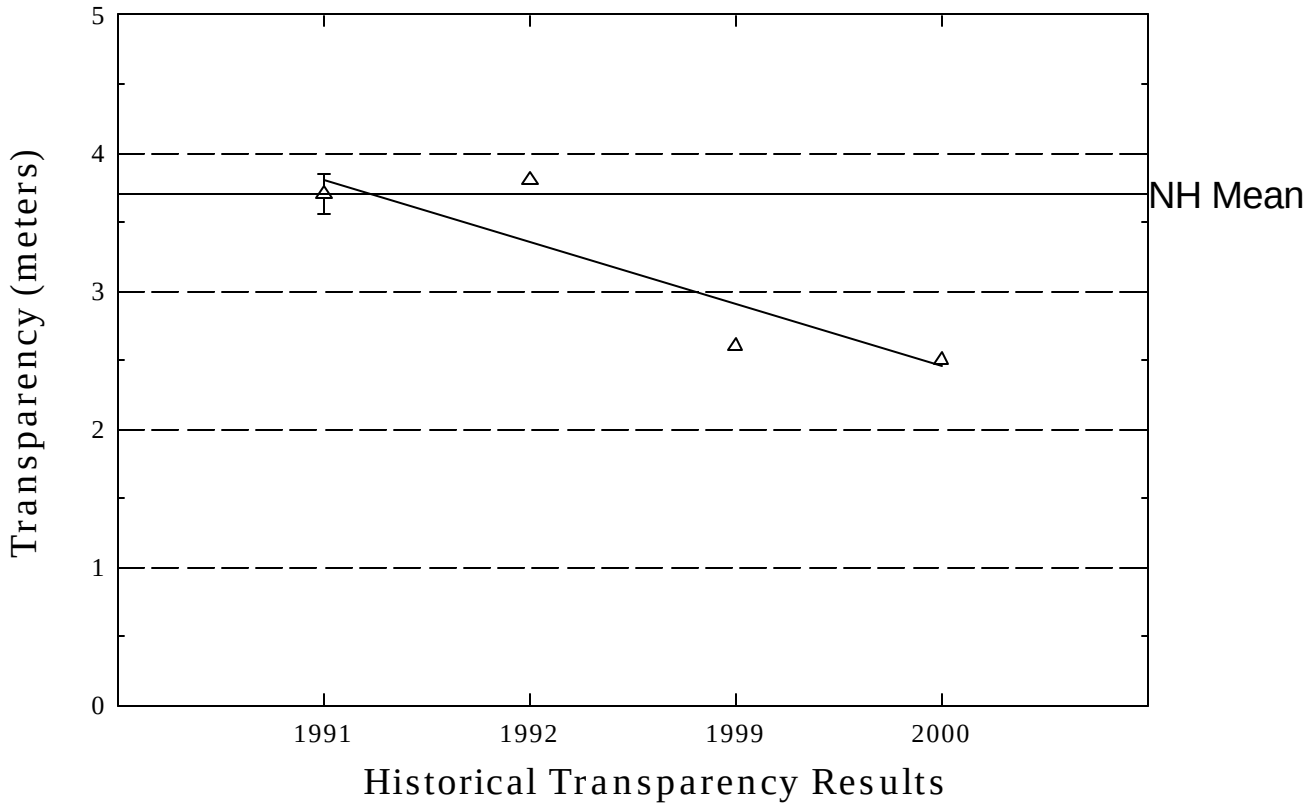


Historical Chlorophyll-a Results

Warren Lake

Figure 2. Monthly and Historical Transparency Results





Warren Lake

Figure 3. Monthly and Historical Total Phosphorus Data.

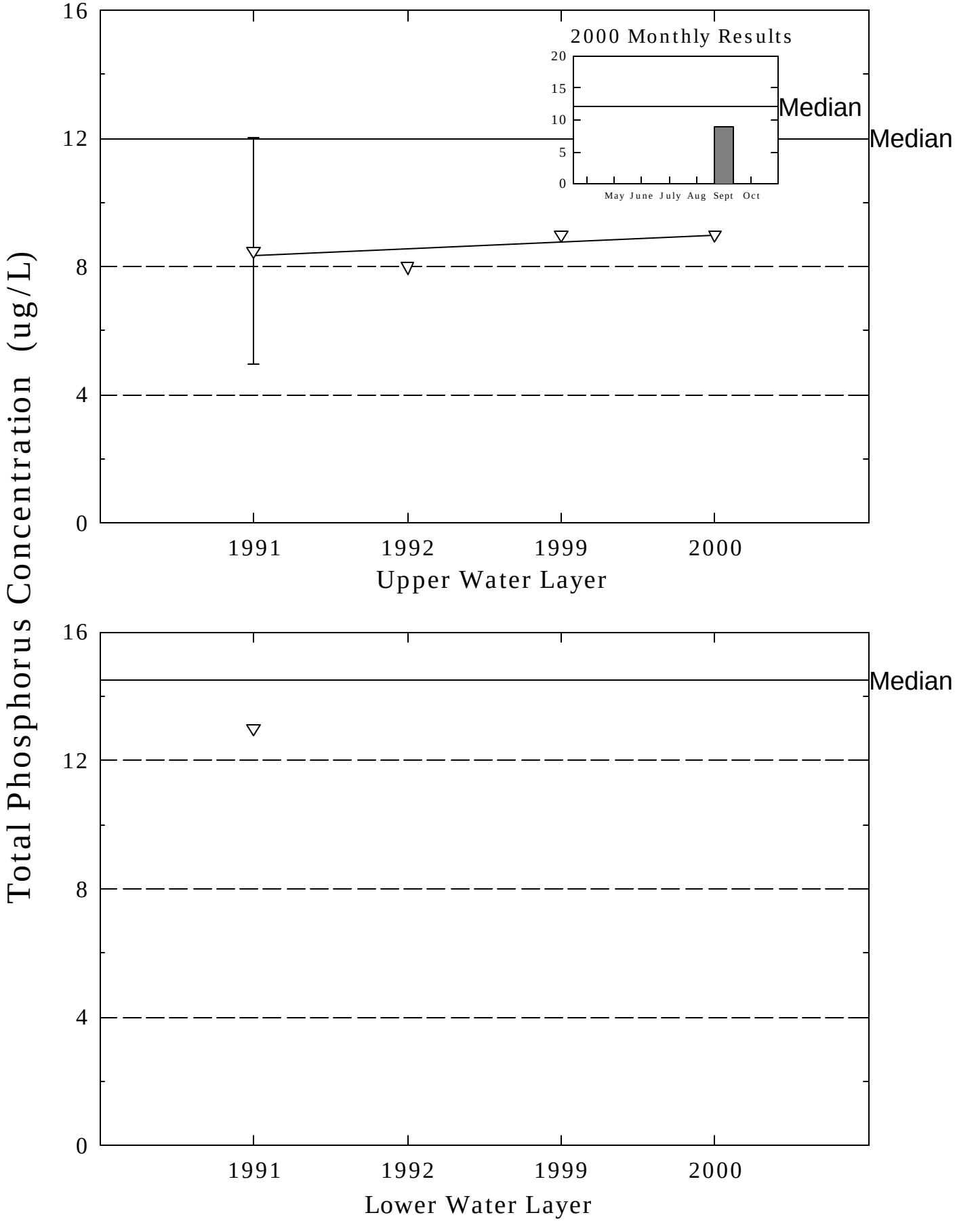


Table 1.

WARREN LAKE

ALSTEAD

Chlorophyll-a results (mg/m^3) for current year and historical sampling periods.

Year	Minimum	Maximum	Mean
1991	1.82	3.80	2.81
1992	3.29	3.29	3.29
1999	9.01	9.01	9.01
2000	7.68	7.68	7.68

Table 2.

WARREN LAKE

ALSTEAD

Phytoplankton species and relative percent abundance.

Summary for current and historical sampling seasons.

Date of Sample	Species Observed	Relative % Abundance
06/24/1991	CHRYSOSPHAERELLA	50
	DINOBRYON	50
09/16/1991	CHRYSOSPHAERELLA	21
	DINOBRYON	52
	ASTERIONELLA	25
09/09/1992	CHRYSOSPHAERELLA	77
08/17/1999	CHRYSOSPHAERELLA	33
	TABELLARIA	64
	RHIZOSOLENIA	1
09/06/2000	DINOBRYON	69
	CHRYSOSPHAERELLA	10
	CERATIUM	8

Table 3.

WARREN LAKE

ALSTEAD

Summary of current and historical Secchi Disk transparency results (in meters).

Year	Minimum	Maximum	Mean
1991	3.6	3.8	3.7
1992	3.8	3.8	3.8
1999	2.6	2.6	2.6
2000	2.5	2.5	2.5

Table 4.

WARREN LAKE

ALSTEAD

pH summary for current and historical sampling seasons.
Values in units, listed by station and year.

Station	Year	Minimum	Maximum	Mean
CARMEN COVE BK				
	1999	6.14	6.14	6.14
CARMEN COVE BROOK				
	2000	6.49	6.49	6.49
COLBURN HILL BK				
	1999	6.61	6.61	6.61
COLBURN HILL BROOK				
	2000	6.62	6.62	6.62
DAM BK				
	1999	6.31	6.31	6.31
EPILIMNION				
	1991	6.50	6.67	6.58
	1992	6.90	6.90	6.90
	1999	6.38	6.38	6.38
	2000	6.68	6.68	6.68
GILSUM RD INLET				
	1991	6.10	6.10	6.10
	1992	6.21	6.21	6.21
HYPOLIMNION				
	1991	6.45	6.45	6.45

Table 4.

WARREN LAKE

ALSTEAD

pH summary for current and historical sampling seasons.
Values in units, listed by station and year.

Station	Year	Minimum	Maximum	Mean
OUTLET				
	1999	6.48	6.48	6.48
PICKEREL COVE BK				
	1999	6.02	6.02	6.02
PICKEREL COVE BROOK				
	2000	6.43	6.43	6.43
RT 123 INLET				
	1991	6.20	6.20	6.20
	1992	6.38	6.38	6.38
SMITH HILL BK				
	1999	5.19	5.19	5.19
SMITH HILL BROOK				
	2000	6.40	6.40	6.40
SPRUCE COVE BK				
	1999	5.45	5.45	5.45
SPRUCE RIVER				
	2000	6.27	6.27	6.27
WARREN BK OUTLET				
	1991	6.20	6.20	6.20
	1992	6.39	6.39	6.39

Table 5.

WARREN LAKE

ALSTEAD

Summary of current and historical Acid Neutralizing Capacity.
Values expressed in mg/L as CaCO .

Epilimnetic Values

Year	Minimum	Maximum	Mean
1991	2.60	3.20	2.90
1992	3.80	3.80	3.80
1999	4.10	4.10	4.10
2000	4.10	4.10	4.10

Table 6.

WARREN LAKE
ALSTEAD

Specific conductance results from current and historic sampling seasons. Results in uMhos/cm.

Station	Year	Minimum	Maximum	Mean
CARMEN COVE BK				
	1999	133.2	133.2	133.2
CARMEN COVE BROOK				
	2000	108.1	108.1	108.1
COLBURN HILL BK				
	1999	102.4	102.4	102.4
COLBURN HILL BROOK				
	2000	58.6	58.6	58.6
DAM BK				
	1999	62.8	62.8	62.8
EPILIMNION				
	1991	53.2	54.8	54.0
	1992	58.9	58.9	58.9
	1999	59.8	59.8	59.8
	2000	59.3	59.3	59.3
GILSUM RD INLET				
	1991	21.2	21.2	21.2
	1992	20.3	20.3	20.3
HYPOLIMNION				
	1991	54.3	54.3	54.3
OUTLET				
	1999	59.8	59.8	59.8
PICKEREL COVE BK				
	1999	34.5	34.5	34.5

Table 6.

WARREN LAKE
ALSTEAD

Specific conductance results from current and historic sampling seasons. Results in uMhos/cm.

Station	Year	Minimum	Maximum	Mean
PICKEREL COVE BROOK				
	2000	25.2	25.2	25.2
RT 123 INLET				
	1991	82.0	82.0	82.0
	1992	68.3	68.3	68.3
SMITH HILL BK				
	1999	37.2	37.2	37.2
SMITH HILL BROOK				
	2000	21.3	21.3	21.3
SPRUCE COVE BK				
	1999	168.8	168.8	168.8
SPRUCE RIVER				
	2000	169.2	169.2	169.2
WARREN BK OUTLET				
	1991	56.3	56.3	56.3
	1992	60.7	60.7	60.7

Table 8.

WARREN LAKE

ALSTEAD

Summary historical and current sampling season Total Phosphorus data. Results in ug/L.

Station	Year	Minimum	Maximum	Mean
CARMEN COVE BK				
	1999	13	13	13
CARMEN COVE BROOK				
	2000	7	7	7
COLBURN HILL BK				
	1999	17	17	17
COLBURN HILL BROOK				
	2000	5	5	5
DAM BK				
	1999	4	4	4
EPILIMNION				
	1991	6	11	8
	1992	8	8	8
	1999	9	9	9
	2000	9	9	9
GILSUM RD INLET				
	1991	37	37	37
	1992	27	27	27
HYPOLIMNION				
	1991	13	13	13
OUTLET				
	1999	1	1	1
PICKEREL COVE BK				
	1999	1	1	1

Table 8.

WARREN LAKE

ALSTEAD

Summary historical and current sampling season Total Phosphorus data. Results in ug/L.

Station	Year	Minimum	Maximum	Mean
PICKEREL COVE BROOK				
	2000	9	9	9
RT 123 INLET				
	1991	2	2	2
	1992	5	5	5
SMITH HILL BK				
	1999	10	10	10
SMITH HILL BROOK				
	2000	30	30	30
SPRUCE COVE BK				
	1999	10	10	10
SPRUCE RIVER				
	2000	11	11	11
WARREN BK OUTLET				
	1991	6	6	6
	1992	6	6	6

Table 9.

WARREN LAKE

ALSTEAD

Current year dissolved oxygen and temperature data.

Depth (meters)	Temperature (celsius)	Dissolved Oxygen (mg/L)	Saturation (%)
		September 6, 2000	
0.1	20.4	6.3	70.2
1.0	20.3	6.3	69.3
2.0	20.1	6.2	67.9
3.0	20.0	5.8	63.7

Table 10.

WARREN LAKE

ALSTEAD

Historic Hypolimnetic dissolved oxygen and temperature data.

Date	Depth (meters)	Temperature (celsius)	Dissolved Oxygen (mg/L)	Saturation (%)
June 24, 1991	3.5	22.6	7.9	91.9
September 16, 1991	3.5	19.0	8.5	92.1
September 9, 1992	3.5	20.0	8.8	97.3
August 17, 1999	3.5	22.2	6.8	78.1
September 6, 2000	3.0	20.0	5.8	63.7

Table 11.

WARREN LAKE
ALSTEAD

Summary of current year and historic turbidity sampling.
Results in NTU's.

Station	Year	Minimum	Maximum	Mean
CARMEN COVE BK				
	1999	1.0	1.0	1.0
CARMEN COVE BROOK				
	2000	0.2	0.2	0.2
COLBURN HILL BK				
	1999	0.5	0.5	0.5
COLBURN HILL BROOK				
	2000	0.1	0.1	0.1
DAM BK				
	1999	0.7	0.7	0.7
EPILIMNION				
	1999	1.3	1.3	1.3
	2000	0.7	0.7	0.7
OUTLET				
	1999	1.4	1.4	1.4
PICKEREL COVE BK				
	1999	0.2	0.2	0.2
PICKEREL COVE BROOK				
	2000	0.1	0.1	0.1
SMITH HILL BK				
	1999	1.1	1.1	1.1
SMITH HILL BROOK				
	2000	1.4	1.4	1.4
SPRUCE COVE BK				
	1999	1.2	1.2	1.2

Table 11.

WARREN LAKE

ALSTEAD

Summary of current year and historic turbidity sampling.
Results in NTU's.

Station	Year	Minimum	Maximum	Mean
SPRUCE RIVER				
	2000	0.6	0.6	0.6

Table 12.

WARREN LAKE

ALSTEAD

Summary of current year bacteria sampling.
Results in counts per 100ml.

Location	Date	E. Coli See Note Below
DAM/BEACH		
	September 6	1
SPRUCE RIVER - DOWNSTREAM OF T		
	September 6	12
SPRUCE RIVER CULVERT		
	September 6	12

NOTE: "<" means "less than" and ">" means "greater than"